

HOME WATER SAFETY

Evaluating the Condition of Your Private Water Supply

by Chris Mechenich and Elaine Andrews

This fact sheet is part of a series designed to help you determine the quality of your home drinking water, and to show you techniques available for improving it. To make the best use of these publications, include them in a household file containing well information and water test results.

Other fact sheets in the series are:

Keeping Your Home Water Supply Safe (G3558-1)

Evaluating the Condition of Your Public Water Supply (G3558-3)

Interpreting Drinking Water Test Results (G3558-4)

Choosing a Water Treatment Device (G3558-5)

The Extension bulletin *Maintaining Your Home Well Water System* (G3399) can be used with these publications.

This series was developed by the University of Wisconsin-Extension in cooperation with the Wisconsin Department of Natural Resources and the Wisconsin Department of Commerce.

IN RURAL AREAS, nearly everyone relies on a private well as the source for domestic drinking water. Few problems shake a homeowner's sense of security as deeply as contamination of the home's water supply.

There are steps everyone can take to help ensure safe, clean well water:

- *Test your water regularly at a certified laboratory.*
- *Evaluate the location of the well and potential contamination sources.*
- *Evaluate the construction of the well.*
- *Record all information you obtain about the well and its water quality.*
- *Take steps to manage any problems or concerns with your water.*

This fact sheet will guide you through the steps needed to evaluate the quality of your well and the water it supplies.

Test Your Water Periodically

Use a certified lab.

Laboratories certified to do chemical analyses by the Department of Natural Resources (DNR) must meet certain standards for accuracy and quality, so you can feel confident the results you receive are correct. A current summarized list of certified labs in Wisconsin is available from your county Extension or local DNR office, or on the DNR web site at www.dnr.state.wi.us/org/es/science/lc/labs/lablists.htm.

Test for bacteria and nitrate.

Tests for coliform bacteria and nitrate are important for the protection of your family's health. A coliform bacteria test will help you determine whether disease-causing bacteria may be entering your water supply. Nitrate is a form of nitrogen that can cause serious illness in infants under six months of age. It may also be an indicator that other contaminants are in the water.

A bacteria test should be taken annually, or any time you notice a change in the taste, odor, or appearance of the water. For the first few years, you should also test water for nitrate. However, you may wish to sample for nitrate less frequently if several annual samples show no elevated nitrate levels.

RECOMMENDED INITIAL SCREENING TESTS FOR A PRIVATE WELL

ALKALINITY — Measurement needed to determine corrosivity.

ARSENIC — Naturally occurring element in soils and bedrock that can be released into the groundwater; can represent a significant health concern.

BACTERIA — Coliform bacteria are usually not harmful, but indicate the possible presence of disease-causing bacteria from human or animal waste.

CHLORIDE — High concentrations of chloride often indicate contamination by a septic system, a landfill, fertilizer, or road salt.

CONDUCTIVITY — Measures the ability of water to conduct an electrical current; can be used to signal the presence of contaminants.

COPPER — Can be leached into water from copper pipes and can represent a significant health threat.

CORROSIVITY — A combination of several tests that indicates the tendency for water to corrode plumbing, or for lime deposits to form in pipes.

HARDNESS — Helps determine the need for water softening; also influences corrosivity.

LEAD — Can be leached into water from lead pipes or solder and can represent a significant health threat.

NITRATE — Nitrate is a form of nitrogen that can dangerously reduce the amount of oxygen in the blood of infants under six months old. Nitrate, introduced into groundwater by humans, is a common contaminant, and often indicates the presence of other contaminants.

pH — This test indicates water's acidity and helps determine if it is corrosive to plumbing.

More information on these initial tests can be found in Testing Your Drinking Water and Interpreting the Results (G3558-4).

Run initial screening tests.

Other tests are important when you first construct or become the owner of a well. A good initial set of tests for a private well includes hardness, alkalinity, pH, conductivity, chloride, arsenic, lead and copper. In areas of coarse sandy soils, thin soils over fractured crystalline (granite-type) bedrock, or where water is naturally soft, calculating a corrosivity index is also important. These tests will provide information about potential health or aesthetic problems with your water. They will also help you determine whether you need further testing. The lead and copper tests may provide information about hazards originating in your home plumbing. *Interpreting Drinking Water Test Results (G3558-4)*, provides a more detailed explanation of the recommended initial screening and annual tests.

More extensive testing may be appropriate if problems are found in the initial testing or if you live near a potential contamination site. In agricultural areas, high nitrate levels might indicate a need for pesticide testing. Near industrial sites or landfills, or underground storage tanks, testing for volatile organic compounds (VOCs) or heavy metals may be appropriate. See Table 1 for possible contaminants from a variety of sources.

Your county Extension office, county health department, or Department of Natural Resources district water supply specialist can also advise you about appropriate tests for your water supply. In addition, the DNR may provide free testing for your water if there are known hazards in your area. DNR may already have results from tests on nearby wells, which could reduce the need for further tests on your well water.

The cost of testing annually for bacteria and nitrate ranges from \$18 to \$30. The cost of the other initial tests recommended in this section will add an additional \$10 to \$50 to your cost. More complex analyses for pesticides or volatile organic compounds (VOCs) may cost hundreds of dollars. Analysis for VOCs should be considered once for each well, especially if problems are discovered in the initial testing, specific symptoms (such as a solvent odor) are noted, or there is a known source of these contaminants in your area.

Evaluate the Location of Your Well and Potential Contamination Sources

Water testing is not enough! A water test provides only a snapshot of today's water quality. However, groundwater quality can change over time. To ensure good water quality for the future, you must be sure that your well is both properly constructed and is located a safe distance from sources of contamination.

TABLE I
POTENTIAL GROUNDWATER CONTAMINATION SOURCES

Activities	Minimum Required Separation Distances from a Well	Possible Contaminants or Indicators (<i>test first for those in blue</i>)
Farming <i>Cropped fields</i>	100 ft.*	Nitrate, pesticides (atrazine)
Livestock facilities	50 ft. (25 for some facilities)	Nitrate, coliform bacteria, TOC, COD
Industrial sites <i>manufacture, mixing, loading and storage</i>	250 ft.*	VOCs used, produced or stored on site
Landfills	1200 ft.	Iron, chloride, COD or TOC, VOC, heavy metals, pH, ammonia, conductivity
Mining of Metals	1200 ft.*	pH, metals being mined, corrosion index, acidity, sulfates
Pesticide <i>mixing, loading or storage</i>	100 ft.*	specific pesticides used in operation
Salt storage	250 ft.	Chloride, sodium, conductivity
Salvage yard	250 ft.	VOC, pH, heavy metals, chloride, conductivity, sulfates
Underground storage tanks <i>(petroleum or chemical)</i>	100 ft. 25 ft. for home heating tanks	VOC, fuel or oil components
Wastewater systems: •septic or holding tank •septic absorption field •lagoons, sludge, etc.	25 ft. 50 ft. 250 ft.	Coliform bacteria, nitrate, chloride, conductivity, ammonia, COD or TOC, sodium
<p>Abbreviations: COD=chemical oxygen demand, or the amount of oxygen needed to oxidize (break down) materials in water. This gives a clue to the amount of organic material present. Organic material contains carbon from living or chemical sources. TOC=total organic carbon, or the amount of organic material. It often indicates the degree to which groundwater is contaminated. VOC=volatile organic compounds, or synthetic chemical compounds, such as gasoline, paint thinners, solvents or others.</p> <p>*Not specifically regulated in Wisconsin; noted distance is closest equivalent.</p>		

SOURCES OF INFORMATION

Publications

University of Wisconsin-Extension

Maintaining Your Home Well Water System (G3399)

Improving Your Private Well Water Quality (G3826)

Available from your county Extension office or Extension Publications, Call toll free: (877)WIS-PUBS (947-7827) or visit <http://learningstore.uwex.edu>

DNR

You and Your Well
PUBL-WS 002 90 REV.

Private Well Construction in Granite Formations
PUBL-WS-017 91 REV.

Lead in Drinking Water
PUBL-DG-015 98 REV.

Nitrate in Drinking Water
PUBL-WS-001 95 REV.

Pesticides in Drinking Water
PUBL-WS-007 93 REV.

Bacterial Contamination of Drinking Water
PUBL-DG-003-2000

Iron Bacteria Problems in Wells
PUBL-WS-004 85

Copper in Drinking Water
DG-027 99

Radon in Private Well Water
WS-036-95

Volatile Organic Chemicals in Drinking Water
WS-009-89 REV

Arsenic in Drinking Water
DG-062 00

Available from DNR, 101 S. Webster St., Madison WI 53707 or DNR regional offices.

Sources of assistance are listed on the back page.

Note the distance between your well and potential contaminant sources.

Whether a well taps into groundwater just below the ground or hundreds of feet deep, the well's location on top of the ground helps determine the safety of the water it produces. A well located too close to a septic system, a livestock yard or a leaking fuel tank runs a much greater risk of contamination than a properly sited well. Wisconsin has had a well code since the mid-1930s that provides minimum standards for well location and construction. Table 1 provides required separation distances from some potential sources of contamination. Remember that these distances are minimums; you may choose to locate your well even further from these sources. If separation distances are not adequate, either the well or the contaminant source must be moved.

Determine the direction of groundwater flow.

It's best to locate your well uphill or upgradient from possible contaminant sources. To do so, consider the direction groundwater flows in your area. Flow direction can usually be estimated by remembering that groundwater normally follows surface contours; that is, it flows from areas high on the landscape to low areas such as lakes, streams and wetlands. Special geologic maps give a more accurate picture of groundwater flow direction. These maps have been developed for some counties; check with the county Extension office to see if they are available for your area.

For more information on sources of groundwater contamination and well placement separation distances, see the state well code (Wisconsin NR 812) and the publications listed in the sidebar.

Evaluate the Construction of the Well

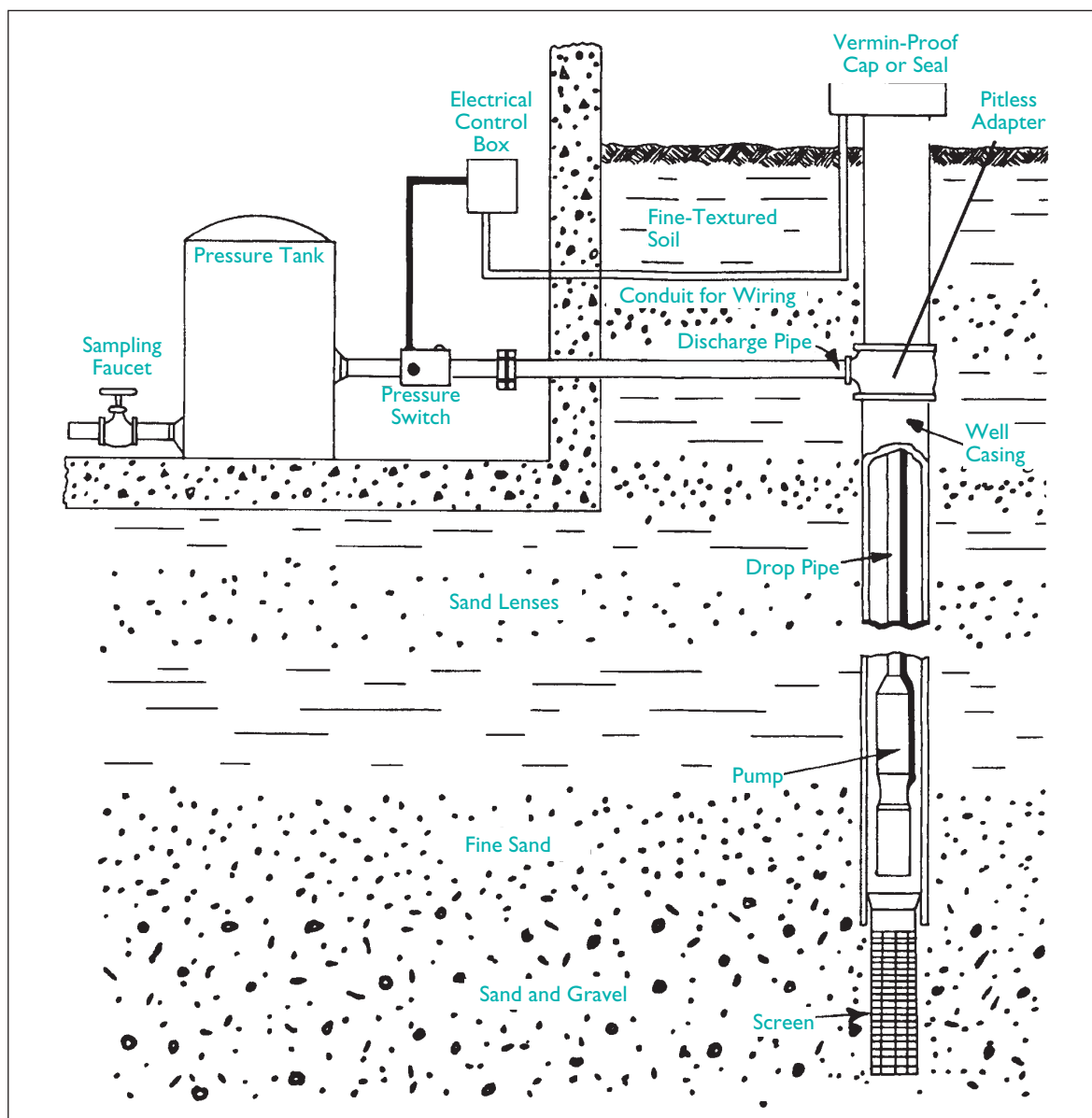
The materials and methods used in the construction of a well affect its ability to keep out contaminants. Poor well design can allow rain or melting snow to carry bacteria, pesticides, fertilizers or other contaminants directly into the well hole. A well that is too shallow, or not cased deeply enough, is at higher risk of collecting contaminated groundwater. Substandard wells should be repaired, reconstructed or replaced by a licensed well driller.

Answering the following questions will help you evaluate the construction of your well.

What type of well is it?

DRILLED OR JETTED WELLS. Some jetted wells are two inches in diameter. Drilled wells are normally 4 to 8 inches in diameter. The well is normally located outside the home, although some older wells may be found in basements or well pits in the yard.

A TYPICAL DRILLED WELL



For a typical domestic drilled well (see illustration) the well driller installs a steel or plastic pipe called casing during construction to prevent collapse of the borehole. The space between the casing and the sides of the hole is sealed with cement or other materials to prevent surface water (and contaminants) from entering the well hole. In addition, the well installer places a tight-fitting cap over the well to keep out surface water, vermin and insects. (Some wells have pumping equipment instead of a cap at the surface.)

Both the casing and the cap can be visually inspected. There should not be any holes or cracks in the casing where it extends above the ground's surface. If the casing can be moved by pushing against it, there might be a problem with its ability to keep out contaminants. The well cap should be on tight and no wiring should be exposed. If the well has an air vent, it should be tightly connected to the cap or seal, facing the ground and screened to keep out insects.

AVOID PROBLEMS WITH BACK-SIPHONING

Many plumbing system components are protected by air gaps. For example, an air gap between a toilet tank valve and the water level in the tank keeps the tank water from mixing back into the home's clean water lines. Air gaps also protect clothes washers and faucets in kitchens and bathrooms. However, some water lines are not always protected with air gaps (e.g., outdoor faucets with hoses and laundry tubs with hoses).

Cross connections or "back-siphoning" can occur when water pressure drops suddenly as a result of a power outage, burned-out fuse or pump motor, a burst water main or similar interruptions in water pressure. The drop in pressure sets up a siphoning effect in the water line, and dirty water can be sucked back into the clean water lines. Examples of possible cross connections in the home include a garden hose connected to a sprayer filled with pesticides or fertilizer, the drain line from a water softener stuck down into the floor drain, or a laundry tub with a hose dangling down into the tub.

If water pressure in your home water supply system is already low, back-siphoning may occur more readily. Fortunately, back flow prevention devices are available in hardware stores for \$5 to \$20 and are easily installed.

SANDPOINT WELLS (drive point, driven well). These wells are normally small in diameter (two inches or less), less than 50 feet deep, and are feasible to install only in areas of relatively loose soils such as sand. These wells were often installed in basements, but this is no longer a legal construction practice, unless the basement is a "walk out."

DUG WELLS. These wells are often large in diameter (18 inches or more) and shallow (less than 30 feet deep). They collect the groundwater nearest the surface and are frequently contaminated with bacteria. Dug wells are not safe water sources.

What do I need to know about my well?

DEPTH OF THE WELL. Depth affects both natural and human-influenced water quality. Generally, deeper wells are less susceptible to contamination caused by human activities.

DEPTH OF CASING. This tells at what depth water may start to enter the well. In wells drilled into rock, this may be much less than the total well depth.

DEPTH TO WATER. Combined with well depth, this tells you how far your well reaches into the groundwater. (For example, a well 100 feet deep with a depth to water of 90 feet, is using the top 10 feet of groundwater). The top portion of groundwater is often the most contaminated.

TYPE OF GROUT OR SEAL AROUND CASING. A well must be properly sealed to prevent contaminated surface water from running down along the casing and directly into the well.

TYPE OF AQUIFER, OR WATER-BEARING MATERIAL. The aquifer may be bedrock, or sand and gravel. The type of geologic material that holds the water can have a major impact on both expected natural water quality and human contamination potential.

AGE OF WELL. The well casing can deteriorate with time, so older wells may be more susceptible to contamination.

WATER YIELD FROM THE WELL. If water flow is inadequate, it can be inconvenient to shower, bathe or do laundry. It might also be a health hazard if inadequate pressure causes back-siphoning, or flow of contaminated water back into the clean water lines (see sidebar).

Most people would like to have water flowing through indoor taps at about six gallons per minute. However, some wells produce far less than that. With adequate storage capacity either in tanks or in the well casing, a family may be able to manage with a well yielding as little as one gallon per minute. Installing a larger pressure tank or a storage tank may provide some help. However, a better way to provide more water might be deepening the well. Contact a licensed well driller or DNR water supply specialist for advice.

Where do I find information about my well?

DRILLED OR JETTED WELLS: If installed since the 1930s, these wells should have a construction report filed with the state (see sidebar). If the report was accurately completed by the well driller and accepted by the state, the well likely met code requirements at the time it was constructed. However, the code is regularly updated to meet changing conditions, and the well may not meet today's standards. If a report is not available, ask previous owners if they know anything about the well depth and the methods and materials used to construct it.

Compare the information you gather about your well to the code requirements found in the state well code (NR 812) or the DNR publication *You and Your Well*. A licensed well driller or pump installer, or DNR private water supply specialist, can also help you determine whether the well meets the current Wisconsin well code.

SANDPOINT WELLS: A licensed driller is not required for this type of well installation. Records of their location or construction were not required before 1989. Ask the builder or previous owner for information on the depth of the well, the depth to water, and the type of materials used.

DUG WELLS: Normally no records are available on their location or construction. Ask the previous owner for any available information.

Record All Information You Obtain About the Well and its Water Quality

Good records about well construction, maintenance and test results will allow you (and those who might buy your home in the future) to evaluate water quality changes over time. *Maintaining Your Home Well Water System* (G3399) available from your county Extension office is printed on a file folder that allows you to record and organize well records. Well records should be kept in a safe place along with other important documents such as your deed or mortgage.

Take Steps to Correct Water Quality Problems

Some water quality problems (such as nitrate or bacteria) pose a health threat and should be corrected immediately. Other water quality problems may simply make the water unpleasant to use. In either case, you may need to do the following to correct these problems.

Replace, repair or reconstruct the well if defects are found in construction.

Gather information from neighbors about their water quality and well construction. If well replacement becomes necessary, any information they can provide may give you clues about drilling

WELL CONSTRUCTION REPORT

If you do not have a well construction report for your well, it is important to try and locate it. The report contains information about:

- **date of well drilling and the owner at the time**
- **distance of structures such as the septic tank from the well at the time of drilling**
- **diameter and depth of the hole**
- **type of casing and other materials used**
- **type and depth of soil and rock formations**
- **depth of water table**
- **water yield**

If there is a problem with your well water, or if you have concerns about the water, this information is critical. The Wisconsin Geological and Natural History Survey in Madison will try to locate the report for a small fee (a minimum of \$10 in 2007). Call 608/262-7430 to request an order form. You will need the legal description of your property (township, range, section, quarter-section and quarter-quarter section), the year the well was installed or the home was built, and the owner's name at the time, if known.

Reports for wells drilled after 1988 may be found on the DNR web site at www.dnr.state.wi.us/org/water/dwg/DWS.htm.

SOURCES OF ASSISTANCE

Water Testing: Certified laboratories (obtain list from DNR or Extension).

Water Test Interpretation: County Extension offices, DNR district offices, county health departments

Well Constructors Report: Available from the Wisconsin Geological and Natural History Survey (WGNHS), 608/262-7430. Also at DNR regional offices.

Well Inspection: Licensed well drillers and pump installers.

Well Compensation Fund: DNR district well compensation coordinators.

Toxicity of Water Contaminants: Wisconsin Dept. of Health and Family Services: 608/266-0923 or 608/266-7480

Wisconsin DNR Regional Offices
Northeast, Green Bay 920/662-5100
Northern, Rhinelander 715/365-8900
Northern, Spooner 715/635-2101
South Central, Madison 608/275-3266
Southeast, Milwaukee 414/263-8500
West Central, Eau Claire 715/839-3700

EPA Safe Drinking Water Hotline
1/800/426-4791

EPA web site:
www.epa.gov/safewater

depths and construction techniques. If the well is contaminated with a health-related substance other than bacteria or nitrate, contact the DNR. Wisconsin's "well compensation program," administered by the DNR, might help pay for a new well.

Remove the source of contamination and allow the water to purify itself.

Relocating the septic system or other source of contamination might solve the water quality problem over time. However, the contaminated water in the aquifer might take years to purify itself through dilution or natural breakdown of the contaminants—too long to be a practical solution in some cases. In such a case you would have to consider additional options.

Buy or carry water.

Carrying drinking and cooking water from a known safe source, or buying bottled water can be temporary solutions to contamination problems. Usually, the water in your home will still be safe for bathing and laundry. However, if it is contaminated with a fuel or solvent, seek additional advice from the DNR water supply specialist. Be sure your new source of water has been tested recently if it is from a nonregulated source such as a neighbor's well.

Develop or connect to an existing community water system.

This may be possible if you live in a large subdivision or close to an urban area. Community water supplies are tested regularly to make sure they meet state and federal drinking water standards.

Treat your water.

Water treatment may be the only answer in some cases. Carbon filters, distillation units and other treatment devices can effectively remove some contaminants from water. However, no system treats all water quality problems, and all systems have limitations. *Choosing a Water Treatment Device* (G3558-5) will help you choose the correct device for your needs.

©2007 by the Board of Regents of the University of Wisconsin System doing business as the division of Cooperative Extension of the University of Wisconsin–Extension. All rights reserved. Send copyright inquiries to Cooperative Extension Publishing, 432 N. Lake St., Rm. 103, Madison, WI 53706.

Authors: Christine Mechenich was formerly a groundwater educator with the Central Wisconsin Groundwater Center, University of Wisconsin–Stevens Point. Elaine Andrews is an environmental education specialist with the Environmental Resources Center, University of Wisconsin–Extension, Cooperative Extension. This publication was updated by Kevin Masarik, groundwater educator at the Central Wisconsin Groundwater Center, University of Wisconsin–Stevens Point.

Issued in furtherance of Cooperative Extension, work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Wisconsin–Extension. The University of Wisconsin–Extension, Cooperative Extension provides equal opportunities in employment and programming, including Title IX and Americans with Disabilities (ADA) requirements. If you need this information in an alternative format, contact the Office of Equal Opportunity and Diversity Programs or call Cooperative Extension Publishing at 608-262-2655.

To see more publications or to order copies of this publication, visit our web site at <http://learningstore.uwex.edu> or call toll-free: 1-877-WIS-PUBS (947-7827).

Home Water Safety

Evaluating the Condition of Your Private Water Supply (G3558-2)

UW
Extension

R-5/2007